



## A REVIEW OF ICE CONDITIONS AND POTENTIAL IMPACT ON HARP SEAL NEONATAL MORTALITY IN MARCH 2007

### Context

Harp seals, *Pagophilus groenlandicus*, are the most abundant pinniped in the northwest Atlantic with an estimated total population size in 2005 of 5.8 million (95% CI= 4.1-7.6 million) (Hammill and Stenson 2005). The Canadian and Greenland hunt for Northwest Atlantic harp seals is the largest marine mammal harvest in the world. Since 2003, the Canadian commercial harp seal harvest has been managed under an Objective Based Fisheries Management (OBFM) approach which incorporates the principle of the Precautionary Approach. Under this approach, precautionary reference levels are identified and are associated with pre-agreed management actions that are to be enacted if the population is estimated to decline further (DFO 2003). Under OBFM, the management objective is to set harvests that will ensure an 80% probability (L20) that the population will remain above the precautionary reference level (N70), of 4.1 million animals. The limit reference level, for this population, also known as a conservation reference level has been set at N30 or 1.7 million animals. In evaluating the impacts of different harvest levels on the population, reported harvests by Canadian and Greenland hunters, losses due to animals struck but not landed or reported, bycatch in fishing gear, changes in reproductive rates, and unusual mortality due to poor ice conditions are taken into account (Hammill and Stenson 2005).

In recent years, poorer ice conditions have been observed compared to conditions observed during the late 1980's and early 1990s (Johnston et al. 2005). Current assessments assume an average mortality of 12% (range 0 to 30%) due to poor ice conditions. However, poor conditions have now been observed in 1998, 2000, 2002, 2005, and 2006. Extremely poor ice conditions were also observed in the southern Gulf of St. Lawrence in March 2007 suggesting that the frequency of this unusual mortality is increasing which would have an impact on the long-term productivity of the herd. In 2007, the ice supporting a significant fraction of the Northwestern Atlantic pup production from the southern Gulf of St. Lawrence drifted rapidly outside of the southern Gulf in early March. This drift of the ice into the Cabot Strait/Sydney Bight areas was unusual and was expected to result in significant mortality of young animals. The southern Gulf component of the population accounts for about 26% of the total pup production of the Northwest Atlantic harp seal population (Stenson et al. 2005). Given this unexpected and potentially high mortality affecting this component, a special advisory meeting was held on March 15, 2007. The objective of this special review was to examine if this potential mortality would require that the advice provided previously to industry and the minister on the impacts of different harvest levels should be revised.

## Background

In the Northwest Atlantic, harp seal females normally give birth in March on the pack ice off the southeast coast of Labrador ('Front') and in the Gulf of St. Lawrence ('Gulf'). Within the Gulf, the majority of harp seals are born on the ice near the Magdalen Islands (Southern Gulf patch) with smaller numbers born in the Northern Gulf (known as the 'Mecatina' patch).

The dates of births differ among the different herds. Births normally begin in late February, with a peak around 28 Feb-2 March, in the southern Gulf. At the Front, births begin in early March with a peak around 8-10 March (Stenson et al. 2005). The dates of births in the Mecatina patch are not well known, but appear to be somewhat intermediate to those in the southern Gulf and at the Front.

During the spring, harp seals require stable ice for giving birth and nursing which lasts for 12-14 days. Once weaned, the young juvenile remains on the ice during which it fasts and moults the white fur (lanugo) to become what is known as a beater. Moulting is normally completed by around the age of 28 days (Kovacs and Lavigne 1985). Beaters begin to enter the water and develop their swimming and diving skills as they learn to feed. At this stage, young seals are more active, but still require ice to haul out on and rest. After about two weeks, the now 4-6 week old beaters begin to move northwards. As their foraging and diving skills develop, their dependence on ice decreases, but animals continue to require access to suitably stable ice large enough for them to haul out on to rest.

In all areas, the location of the whelping patches show considerable interannual variation. In the southern Gulf, pups are normally born on the ice off the northwestern side of the Magdalen Islands, but may also occur off the north coast of Prince Edward Island (Fig. 1) (Sergeant 1991). This ice normally remains in the Gulf of St. Lawrence until early April (Fig. 1) (Sergeant 1991). In 2007, some pupping occurred on ice northwest of the Magdalen Islands, but the majority of pups were born on the ice off the northeastern shore of Prince Edward Island in early March. By March 12, 2007, all animals from the Southern Gulf component had drifted out of the Gulf of St. Lawrence to the Sydney Bight area off the northeastern coast of Cape Breton Island. Surveillance flights by the DFO Science, as well as Conservation and Protection, determined that the ice supporting these pups was generally located approximately 10 to 40 nautical miles~20-80 km offshore.

The Northwest Atlantic harp seal population is normally assessed every 4-5 years. Following this assessment, the results are reviewed by the National Marine Mammal Review Committee and advice on the status of the stock as well as the impacts of various harvest scenarios on the herd are provided to fisheries managers. In 2004, an aerial survey produced an estimate of total pup production of 991,400 (95% CI=877,300-1,105,500); the southern Gulf component accounted for ~26% of total pup production or approximately 261,000 seals.

Because of the limited ice cover and more severe sea conditions in the Sydney Bight area, ice destruction was expected to be more rapid than would have been expected in the Gulf of St. Lawrence. Given the relatively young age of the pups (90% were approximately 12 days old on 12 March) and their need for a suitable ice platform for at least another two weeks, the deteriorating ice conditions, and the weather conditions in this area, it was likely that the pup mortality in the southern Gulf of St. Lawrence would be very high (>75%). Given these conditions, Science was asked 1) to provide advice on the impact of such a high mortality of the pups from the southern Gulf component on the Northwest Atlantic harp seal population as a

whole , and 2) to determine whether this mortality would require changes in the science recommendations for the 2007 harvest.

## Evaluation

The following points were made during the meeting:

- The Atlantic harp seal population is considered a single stock, however tag returns show that there is some site fidelity with Front animals returning to the Front and Gulf animals returning to the Gulf. Based on the four pup production surveys carried out between 1990 and 2004, about 70% of the pups are born in the Front and 30% are born in the Gulf of St. Lawrence. Fisheries and Aquaculture Management (FAM) has traditionally managed the allocations at the Front and in the Gulf based on this split to maintain the integrity of each herd; allocations are based on the average proportion of pupping that takes place in each area to maintain the relative abundance of each herd.
- Pup production in the Gulf of St. Lawrence occurs in two areas: the Northern Gulf (Mecatina patch) and the Southern Gulf. Based on the average from four pup production surveys carried out between 1990 and 2004, about 23% of the pups are born in the southern Gulf while 7% are born in the northern Gulf. In 2004, 26% of total pup production occurred in the southern Gulf. The Mecatina patch is usually small, but estimates of current size are confounded because in some years surveys include Front pups that drift into the Gulf. In April, further mixing occurs as pups born in the southern Gulf migrate northward.
- It is not possible to provide a quantitative estimate of the pup mortality in the southern Gulf in 2007. If weather conditions are poor in the last 2 weeks of March and the ice breaks up, we would expect the mortality to be very high, possibly approaching 100%.
- Ice conditions in the northern Gulf and at the Front this year appear to be good and there is no reason to suspect that the pup mortality would be higher than usual in these areas.
- The impacts of different levels of mortality were examined using the same population model as used during the last full assessment done in 2005. The model was updated to take into account recent reported harvests from the Canadian commercial hunt, but assumptions concerning levels of animals struck and loss, Greenland harvests and reproductive rates were the same as in the 2005 assessment (Hammill and Stenson 2005). Based on these new calculations, the population currently numbers around 5.5 million (95% CI=3.8-7.1 million) animals.
- The current population projection model used in the assessment includes an additional natural mortality factor that averages 12% (range 0-30%) for the entire population to account for unusual mortality. It is assumed that some sort of unusual mortality will occur in 3 out of 5 years. If applied to the Southern Gulf production only, and if there is no additional mortality in other areas, this additional mortality translates to a loss of 48% of the Southern Gulf production.
- The impact of additional mortality (50%, 75% and 100%) in the southern Gulf was examined using the assessment model, with three harvest scenarios and compared to conditions of no additional mortality (Table 1). The effect of the higher mortality on the 2007 southern Gulf cohort has relatively little impact on the short-term projections already provided for the current management plan. Model simulation using high (>50%) pup mortality in 2007 indicates that L20 would reach N70 about one year earlier than what was initially predicted for each scenario. However, the greater impact of high mortality in 2007 will be on the long-

term population dynamics and age structure. A scenario with a harvest of 290,000 animals in 2007 would result in the population falling below N70 in 2009, before the end of the current management plan.

- Poor ice conditions have been observed in 1969, 1981, 1998, 2000, 2002, 2005, 2006 and 2007). The frequency of poor ice has increased in recent years. An increase in mortality in the Southern Gulf component or a decrease in access to this patch due to deteriorating ice conditions will result in a change in the distribution of hunting effort. If hunting in the Gulf is repeatedly directed disproportionately to the Mecatina group, this could result in loss of this component.

*Table 1. Impacts of different levels of additional Southern Gulf pup mortality due to poor ice conditions in 2007 on the time for the herd to decline to the N70 population level. Each scenario indicates the harvest rate for the next 4 years (2007, 2008, 2009, and 2010), then declines to replacement yield (RY, '000) rounded to the nearest 5,000 in 2011 and future years (+). The last year a harvest can be carried out without L20 falling below the N70 population is given for each scenario. In 2008 and future years, an average of 12% additional pup mortality was applied across the herd as per the most recent stock assessment. The first scenario (with 100% mortality) would result in the population falling below N70 before the end of the management plan in 2010.*

Scenario ( '000s)	Additional pup mortality applied to Southern Gulf herd							
	0%	RY	50%	RY	75%	RY	100%	RY
290,250,200,150,	2011	145+	2010	140+	2010	135+	2009	130+
275,250,200,150,	2011	150+	2010	140+	2010	140+	2010	135+
250,250,200,150,	2012	150+	2011	145+	2010	140+	2010	140+

## Conclusions

- Due to higher harvest levels over the last decade, particularly since 2003, and increased pup mortality due to a series of poor ice years, the estimate of L20 of the NW Atlantic harp seal population is declining.
- If conditions in the southern Gulf in 2007 result in another year of high level of pup mortality, as appears likely, this will further contribute to the decline.
- The full impact of this mortality will not be realized for at least 5 years when this cohort begins to contribute to pup production.
- The overall impact of increased Southern Gulf pup mortality on the long-term population dynamics of harp seals also depends upon reproductive rates, Greenland and Canadian harvest levels and future ice conditions.
- In the short term, high additional pup mortality in the Southern Gulf (>50%) is predicted to result in the population reaching N70 approximately 1 year earlier than predicted in the model scenarios presented to industry in January 2007.
- As indicated in the earlier advice, maintaining high initial quotas would require more significant decreases in catches in future years to adhere to the management plan.

Research Recommendations:

- The relationship among the different pupping components, particularly in the Gulf, needs to be examined in greater detail to better understand the implications of changes in ice conditions on pup mortality and the impacts of the potential change in the distribution of hunting effort on the NW Atlantic harp seal population.
- The apparent higher frequency of poor ice condition in recent years may require that the value for this additional mortality factor be examined in greater detail in the next full assessment of this population expected in 2009.

**Other Considerations**Further observations based on information obtained during late March-May and April, 2007

In surveys flown 10-12 March, neonates (fat whites, greys, and ragged jackets) at the eastern edge of the Southern Gulf patch were older than pups found at the western edge of the patch along the northwest Cape Breton shore. During the last two weeks of March, ice conditions continued to deteriorate. Ice deterioration in the eastern part of the pack, was offset to some extent by the movement of ice out of the Gulf into the Sydney Bight area. Throughout this period no large concentrations of beaters were seen.

Hunting began in the southern Gulf and off northeastern Cape Breton in early April and in the northern Gulf at the end of the first week of April. However, only a few seals were taken off the east coast of Cape Breton Island and in the southern Gulf. Most of the hunters went to the northern Gulf, but no large concentrations of beaters were seen in the northern Gulf during flights conducted by DFO Conservation and Protection. By May 2, 2007, after approximately one month of hunting, a total of 61,400 seals (89% of the quota) were taken. In contrast, 140,600 (152% of the quota) were taken in 2006 during a hunt that lasted less than 5 days.

In conclusion, the absence of observations of large numbers of hauled out beaters and the low Gulf catch and catch rates suggest that mortality of the Southern Gulf component of the Northwest Atlantic harp seal population was extremely high in 2007.

**Contributors**ParticipantAffiliation

Mike Hammill (co-author)  
Garry Stenson (co-author)  
Don Bowen  
Peter Olesiuk  
Patrice Simon (chair)

DFO, Science, Quebec Region  
DFO, Science, Newfoundland Region  
DFO, Science, Maritime Region  
DFO, Science, Pacific Region  
Marine Mammal Peer Review Committee, DFO, Science,  
National Capital Region  
DFO, Science, National Capital Region  
DFO, Science, National Capital Region  
DFO, Fisheries and Aquaculture Management,  
National Capital Region

Ghislain Chouinard  
Jean Landry  
Mike Calcutt



### Approved by

Patrice Simon (chair), Marine Mammal Peer Review Committee, DFO, Science, National Capital Region

### Sources of Information

DFO 2003. Atlantic seal hunt 2003-2005 management plan. Fisheries and Oceans Canada, fisheries Management. 34 p.

Hammill, M.O. and G.B. Stenson. 2005. Abundance of Northwest Atlantic harp seals (1960-2005). DFO Can. Sci. Advis. Sec. Res. Doc. 2005/090. 38 p.

Johnston, D.W. A. S. Friedlaender, L. G. Torres, D. M. Lavigne. 2005. Variation in sea ice cover on the east coast of Canada from 1969 to 2002: climate variability and implications for harp and hooded seals. *Climate Research* 29:209-222.

Kovacs, K.M., and D.M. Lavigne. 1985. Neonatal growth and organ allometry of Northwest Atlantic harp seals (*Phoca groenlandica*). *Canadian Journal of Zoology* 63:2793-2799.

Sergeant, D. E. 1991. Harp seals, man and ice. Canadian Special Publication of Fisheries and Aquatic Science 114:153p.

Stenson, G.B., Hammill, M.O., Lawson, J., Gosselin, J.F., Haug, T. 2005. 2004 Pup Production of Harp Seals, *Pagophilus groenlandicus*, in the Northwest Atlantic. DFO Can. Sci. Advis. Sec. Res. Doc. 2005/037.

## Appendices

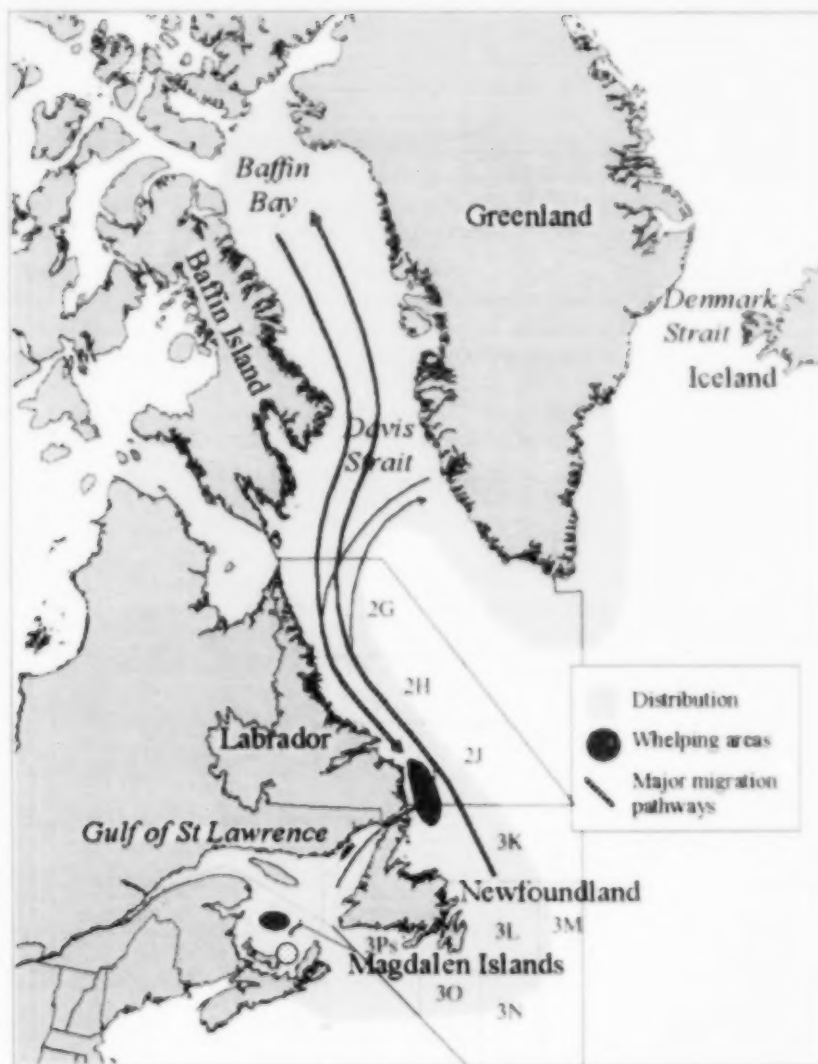


Figure 1. Typical locations of harp seal whelping patches (solid shapes) off southern Labrador-northeast Newfoundland (Front), in the northern gulf of St. Lawrence (Mecatina) and southern Gulf of St. Lawrence (southern Gulf) during the month of March. The hatched circle shows the unusual location of the southern Gulf patch by mid-March, 2007.

**This Report is Available from the:**

Canadian Science Advisory Secretariat  
National Capital Region  
Fisheries and Oceans Canada  
200 Kent Street  
Ottawa, ON K1A 0E6

Telephone: (613) 990-0293  
Fax: (613) 954-0807  
E-Mail: [CSAS@dfo-mpo.gc.ca](mailto:CSAS@dfo-mpo.gc.ca)  
Internet address: [www.dfo-mpo.gc.ca/csas](http://www.dfo-mpo.gc.ca/csas)

© Her Majesty the Queen in Right of Canada, 2007

*La version française est disponible à l'adresse ci-dessus.*



**Correct Citation for this Publication:**

DFO, 2007. A Review of Ice Conditions and Potential Impact on Harp Seal Neonatal Mortality in March 2007. DFO Can. Sci. Advis. Sec. Sci. Resp. 2007/008.